# Economic analysis of the European cement industry

Marcel Boyer, Jean-Pierre Ponssard

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## Abstract

We present a methodology to assess the profitability of a capital intensive industry over a business cycle and to make projections of profitability for different investment strategies under various hypothetical scenarios for environmental and competition policies. The methodology is applied to the European cement industry over the period 2004-2012 (Part I) and over the next 10/15 years (Part II) using publicly available data, interviews of financial analysts and industry experts.

**Key words:** return on assets, capital intensive industry, business cycle, European cement industry.

## Résumé

Nous développons une méthodologie pour évaluer la performance financière ex-post d'un secteur à forte intensité en capital lors d'un cycle économique et étudier la rentabilité future de différentes stratégies d'investissements face à différentes politiques de concurrence et environnementale. Cette méthodologie est appliquée au secteur cimentier en Europe respectivement pour la période 2004-2012 (Partie I) et pour les 10/15 prochaines années (Partie II). Les résultats s'appuient sur des données publiques et sur des interviews d'analystes financiers et d'experts du secteur.

**Mots clés :** rentabilité des actifs, secteur à forte intensité en capital, cycle économique, industrie cimentière européenne.

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# Part I: Assessing the profitability of a capital intensive industry over a business cycle The European cement industry over 2004-2012

## Executive Summary


The European cement industry follows a networking strategy which goes with some market power inherent to the economic characteristics of this industry. This facet of its business model has created a recurrent debate between the regulatory authorities and the cement industry.

This debate has been exacerbated in Europe by the intensity of the recent financial crisis combined with the uncertainty of future environmental regulation to the point that the sustainability of the European cement industry is now at risk. It is quite possible that the European cement industry will face a durable lack of investment leading to a progressive decline. The debate is further blurred due to the focus of the authorities on the level of profit margins routinely observed in the cement sector.

This report defines the reasonable profitability indicator for the cement industry as the average return on capital employed (ROCE) in the long run compared to the weighted average cost of capital (WACC).

Based on our estimates, the average ROCE over the recent business cycle 2004-2012 is around 5.3 % while the WACC is approximately at 9%. This means that the cash flow generated by the cement activity did not cover the expected or required return for the invested capital.

A detailed analysis is made in which Western Europe is contrasted with Eastern Europe. Both regions generate different average ROCE (4.3 % versus 14.1%). The expansion (2004-2007) and contraction (2008-2012) phases of the business cycle are also distinguished.

The detailed analysis identifies the following points:

- ✓ Price changes explain the increase in ROCE in the expansion phase, this impact being somewhat mitigated in the West by an increase in cost.
- ✓ The major driver that explains the decrease in profitability in West during the contraction phase is the increase in cost, the decrease in volume and the increase in the utilization rate come second, the price increase moderately increases the profitability.
- ✓ The decrease in profitability in the contraction phase in East is uniformly associated the decrease in volume, capacity utilization, price, and increase in cost.
- ✓ The relative profitability in Eastern Europe will be endangered as the construction cost of new plants progressively converges to that in Western Europe (250$/t versus 130 $/t respectively according to Jefferies).

This analysis delivers two conclusions: (i) EBITDA/Sales as such is a poor proxy measure of profitability, it need be completed by the capital intensity (ii) these two factors are interdependent and need be put in a proper time perspective to evaluate the profitability of the cement industry since they considerably varied over the recent business cycle resulting into a ROCE at 10 % at its peak in 2007 to a ROCE at 0.4 % in 2012.

# Part II: Making projections of profitability for different investment strategies The European cement industry over 2013-2025

## Executive Summary

Part I of this study showed that the lack of profitability of the European cement industry during the recent business cycle has put the industry at risk.

Part II identifies the future conditions that may trigger investment and capacity adaptation over the next 10-15 years.

Two extreme views may be formulated regarding the future of the European cement industry.

- The maturity of the cement demand is such that there is no need for future investments. Market forces should lead to the closing of inefficient plants and the price level should converge to the operational cost.

- There are opportunities for substantial cost improvements through a significant restructuring of the industrial base to concentrate production in large *best-in-class* plants.

A general methodology has been elaborated to compare these two scenarios. It gives due consideration to the role of market concentration on price and the impact of the price on import penetration. A sensitivity analysis has been made with respect to the stringency of the future European environmental policy.

Based on cost and market estimates we show that

- Closing of existing plants to restore a satisfactory level of capacity utilization would be an extremely profitable move but this move is not enough to maintain the intrinsic profitability of the European industry (the ROCE remains below the wacc) and the competitiveness of the industry remains at risk.
- Once Closing is carried on, the investment in new *best-in-class* plants in Europe would restore significantly the competitiveness of the industry but this would not be a profitable move.
- If this investment strategy may benefit from merging and acquisition activities among European firms, the occurrence of which depends on the Competition authorities, such a strategy would both restore significantly the competitiveness of the industry and be a profitable move. It would also put the industry in a sustainable intrinsic profitability state (ROCE higher than the wacc).

These general policy conclusions need be reassessed on a case by case basis, depending on the regional conditions which may significantly differ across European markets.

## 1. Scope of Part I study Challenges for the European cement industry

An industry economic analysis should begin from the well known structure-conduct-performance paradigm, in which market structure is mainly determined by market size and exogenous economies of scale. Then it should proceed by analyzing the strategic behavior of firms and its possible implications on market power and social welfare. Finally, a proper measure of performance must be defined and assessed.

### 1.1 Structure

For the cement industry in general, the first step already provides important insights:

- The regional demand for cement is more or less proportional to the local density of population and disposable income, the growth potential of which depends on the development of the country.
- Cement, quality wise, is a homogenous product, but a high transportation cost relative to the ex-work cost creates a strong spatial differentiation.[3]
- The production of cement is carried on in large plants, the size of which is technologically determined; moreover, once built, the capacity of a given plant cannot be increased unless a large re-investment is undertaken.[4]
- The industry is capital intensive (the ratio of investment cost to sales is of the order of 2 to 3 which is one of the highest in industry). [5]

These four factors make geography critical for limiting de facto the number of competitors in any one location.

A fifth important additional factor need be taken into consideration:

- Compared to a fixed supply capacity, regional demand can appear to be quite volatile. This generates significant regional differences between supply and

[3] Note that there may be large differences regarding road, rail or sea transportation costs.
[4] A cement plant needs a limestone quarry, which is a scarce resource subject to environmental regulations; on top of that, a cement plant ordinarily operates for more than 20 years.
[5] The capital intensity somewhat decreases with the increase of the cement to clinker ratio that occurred in the recent years.

demand which need be balanced with inter-regional flows, some from adjacent regions, others, in particular if the region is accessible by cargo ships, through long haul flows.

The long term growth potential combined with the short term demand uncertainty and the rigidity of capacity make investment the major critical decisions. These decisions determine the success or failure of a company.

### 1.2 Conduct

Firms have deployed various strategies to cope with long term demand perspective and limit the impact of uncertainty. Historically firms diversified into other businesses, a strategy that has not been valued by financial markets since the management capabilities may not be transferable.

In the last decades firms diversified across regions to take advantage from temporary excess capacity in one region to transfer shipments to another one in which demand exceeds capacity. Periodically firms also engaged into vertical integration in ready-mix concrete so as to secure the demand for a large sunk cost in cement production. This strategy means that firms operate a large network of more or less inter-connected cement plants, grinding stations and ready mix plants.

This strategy encourages investment because it reduces the uncertainty of any one investment decision taken separately; it helps to incorporate new technologies which enhance social welfare.

### 1.3 Performance

However this strategy of the cement industry goes with some market power inherent to the economic characteristics of this industry. This facet of their business model has created a recurrent debate between the regulatory authorities and the cement industry. The tension between the business model of the industry and the regulatory authorities largely explains the evolution of the European cement industry. [6]

[6] Until the eighties the cement historical national leaders had mostly invested in their home country and outside Europe. Two major changes explain the progressive emergence of the EU market as such: the antitrust policy partly moved from the national levels to the EU level (in 1994 the industry was inflicted

This debate has been exacerbated by the intensity of the recent financial crisis combined with the uncertainty of future environmental regulation in Europe to the point that the sustainability of the European cement industry is now at risk. It is quite possible that the European cement industry will face a durable lack of investment leading to a progressive decline as experienced by the US cement industry in the seventies. [7]

The debate is further blurred by the focus of the authorities on the level of profit margins routinely observed in the cement sector. But profit margins cannot be considered as a credible and reasonable profitability indicator in a capital intensive sector and a much more thorough analysis is required in which the time dimension is explicitly introduced to understand the role of business cycles on investment. A better understanding of the profitability or lack of profitability of the industry is necessary, even essential.

This report defines what should be a reasonable profitability indicator for the cement industry and evaluates this indicator for the European industry over the recent decade. The analysis takes into consideration the position of the industry over the business cycle and its important impact both on long term capacity adaptation as well as short term evolution of prices and operational costs. This allows for a proper assessment in which the short term profitability indicators are put in a consistent long term perspective.

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fines for barriers to intra flows within the EU), a technology innovation made sea transportation of cement much less costly than before (through bulk rather than bags) increasing import pressure on coastal markets as well as inland through a ripple effect on prices. Nowadays, a large number of cement firms operate all over Europe. While this has undoubtedly increased market concentration, there remains a significant number of small independent cement producers.

[7] This is documented in *Creative management in mature capital intensive industries: the case of cement*, Collomb, B. and Ponssard, JP, in A. Charnes and WW. Cooper (eds.) *Creative and Innovative Management*, Cambridge, Ballanger, 1984. For general references on the historic evolution of the cement industry see *Understanding and regulating the market at a time of globalization: the case of the cement industry*, Dumez, H. and Jeunemaître, A., Palgrave, 2000.

## 2 The assessment of profitability

Financial theory defines profitably as the return of investment.[8] For listed companies this is ordinarily assessed through a comparison of its total shareholder return (TSR) compared to the company cost of equity (CoE). The cost of equity incorporates the expected market return for an optimally diversified portfolio and the systematic risk of the company asset i.e. its risk relative to the portfolio risk given by its *beta*.

Within a company, the profitability is ordinarily assessed through a cash flow analysis using the weighted average cost of capital for discounting (WACC). The weighted average cost of capital consists of two parts: the cost of equity and the net cost of debt after tax. Ordinarily, that is except when there is a risk of liquidity and bankruptcy for the company at stake, financial markets assess the cost of equity and the net cost of debt after tax as sector averages rather than company specific. Under these circumstances both the CoE and the WACC evolve slowly over time. When analyzing cash returns, a positive discounted cash flow is equivalent to have the average over time of yearly returns on capital employed (ROCE) above the weighted average cost of capital.

The comparison of the observed value for the average ROCE over time with the WACC can be interpreted as follows:

- If over time ROCE < WACC, the activity has not been creating value i.e. the cash flow generated by the activity does not cover the capital invested.
- In such a case the company faces the choice of limiting its future investment or to restructure its activity to get higher margins.

Table 1 gives the average TSR computed as the weighted average TSR of a representative set of listed world cement companies. The figures are for various periods that will be seen to be associated respectively with the expansion and contraction phases of the European business cycle. They are compared with the values obtained for its peer group of listed world companies operating in industrial goods.

Graph 1 gives the yearly TSR and ROCE for a representative company of the cement sector and compares these yearly values with CoE and WACC. As expected the two benchmarks CoE and WACC evolve slowly while the yearly indicators TSR and ROCE fluctuate over time.

[8] See Brealey R.A. and Myers S. C. *Principles of corporate finance*, McGraw Hill, 2002.

**Table 1: TSRs based on calendar year data in local currency**
Source: Thomson Reuters Datastream; BCG analysis

**Market Cap Weighted Group average**

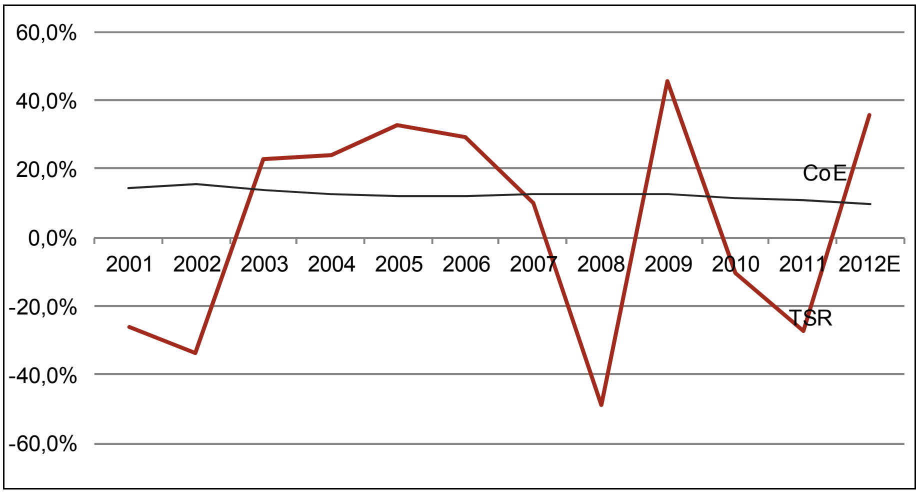
Market capitalization in $m as of 01/01 of each year

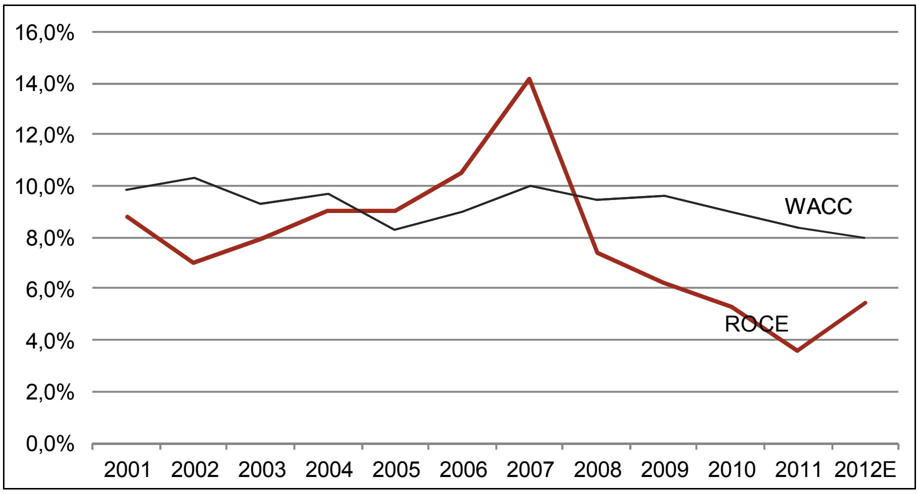
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reference Group (industrialized goods | | **18,9%** | | **2,5%** |
| | | | Cement | | **20,1%** | | **-8,9%** |
| | | | | | 5 years | | 6 years |
| # | Ticker | Ticker | Company | MV 2003 | 03-'07 | MV 2007 | '07-'12 |
| 1 | P:CPR | P:CPR | Cimentos De Portl.Sgps | 2 256 | 17,9% | 5 574 | -5,7% |
| 2 | CRH | CRH | Crh | 6 491 | 19,8% | 22 566 | -3,5% |
| 3 | S:HOLN | S:HOLN | Holcim 'R' | 1 933 | 23,6% | 23 144 | -5,2% |
| 4 | U:VMC | U:VMC | Vulcan Materials | 3 806 | 18,5% | 8 486 | -6,7% |
| 5 | I:BZU | I:BZU | Buzzi Unicem Vincoli | 933 | 26,5% | 4 458 | -9,8% |
| 6 | D:HEI | D:HEI | Heidelbergcement | 2 369 | 32,1% | 16 868 | -12,0% |
| 7 | F:LFG | F:LFG | Lafarge | 10 004 | 17,3% | 26 195 | -8,4% |
| 8 | G:TITK | G:TITK | Titan Cement Cr | 1 457 | 13,8% | 4 180 | -15,3% |
| 9 | MX:CMC | MX:CMC | Cemex 'Cpo' | 6 716 | 23,6% | 25 858 | -13,0% |
| 10 | I:IT | I:IT | Italcementi Fabbriche Riunite | 1 784 | 11,4% | 4 991 | -22,0% |

**Graph 1: Yearly TSR versus cost of equity (CoE) and ROCE versus weigthed average cost of capital (wacc)**

cement company illustration 2001-2011

(source Jefferies, TSR from BCG)



It can be seen that overall the TSR for cement, while somewhat higher than its peer value in the expansion phase 2003-07, is significantly lower in the contraction phase 2007-12. Note also that the yearly TSR is extremely volatile. The TSR integrates both industry fundamentals and market expectations which may explain its extreme volatility. The ROCE only reflects the fundamentals of the industry and evolve more slowly.

In this study we shall focus on the yearly ROCE and compare its average over time with an average value of the WACC which can be inferred from Graph 1 to be about 9%.[9]

## 2.1 Obtaining ROCE for cement

While company ROCE can be directly computed from their financial statements, these statements do not provide data, by business lines on predefined geographic areas, for sales, EBITDA margins, depreciation allowances and capital employed. We develop a specific methodology that bypasses this difficulty and allows us to obtain the ROCE for the cement business activity in Europe.

We start from the approach BCG used in its study for CEMBUREAU.[10] In this study a weighted average ROCE for Europe is constructed based on a representative set of company ROCEs; for each ROCE the total book value is allocated in proportion of their respective share of total capacity and the cost of a new plant by geographic areas (as documented in Jefferies).

We go from this BCG ROCE to a ROCE for cement in Europe as follows.

We show that one can obtain a very good approximation of the BCG ROCE using industry averages for tax rate, depreciation allowances, and unit capacity cost. The quality of this adjustment can be seen table 2.

We shall test whether a geographic distinction between Western and Eastern Europe make sense for two reasons: (i) as will be seen the average growth and amplitude of the business cycle differ, (ii) the cost of building a new plant also differ significantly (250$/t versus 130 $/t respectively according to Jefferies).

We use the EXANE BNP PARIBAS database per country to construct the EBIT at the industry level for cement both in Western EU and Eastern EU. This database provides market and financial figures per country for cement consumption, capacity, price and EBITDA/sales. The countries for which we have data are given in table 3.

This data base allows for testing the impact of excluding non EU27 imports and exports from total consumption and capacity respectively.

[9] A slight progressive decrease from 10% to 8% over the period may be inferred from Graph 1; given the order of magnitude of the observed ROCE this does not affect our analysis.

[10] *The Cement Sector: A strategic Contributor to Europe's Future*, Boston Consulting Group, Draft version, February 2013.

## Table 2: From the BCG ROCE to an industry ROCE

| | 2008 | 2009 | 2010 | 2011 | 2012E |
|---|---|---|---|---|---|
| Average ROCE Industry | 9,7% | 4,8% | 3,3% | 3,2% | 1,9% |
| Average ROCE BCG | 10,1% | 4,4% | 3,2% | 2,7% | 2,1% |

## Table 3: Country scope for the study (source Exane)

| | |
|---|---|
| Portugal | Czech Republic |
| France | Hungary |
| Spain | Poland |
| Italy | Slovakia |
| Greece | Romania |
| Benelux | Bulgaria |
| Ireland | **EASTERN EUROPE** |
| Finland | |
| Germany | |
| Austria | |
| Norway | |
| Denmark | |
| Sweden | |
| UK | |
| **WESTERN EUROPE** | |

## 2.2 Methodology

Our methodology to calculate the yearly ROCE can be summarized as follows:

I. As denominator a yearly value for capital employed obtained with

- ✓ a constant unit capacity cost
- ✓ yearly values for capacities

II. As numerator a yearly value for EBIT*(1 –tax rate) obtained with

- ✓ constant parameters for tax rate and depreciation allowances as a percentage of capital employed
- ✓ yearly values for EBITDA

The calibrated values of the parameters are given in table 4. The average ROCE is obtained as average of yearly ROCE weighted by yearly capital employed.

## Table 4: Calibrated values of the parameters

| Parameter | | |
|---|---|---|
| Tax rate % | | 23% |
| Depreciation Allowances as % of Capital Employed | | 4.3% |
| Unit capacity cost €/t (€ 2011) | | |
| | Total Europe | 165 €/t |
| | Western Europe | 183 €/t |
| | Eastern Europe | 95 €/t |

# 3 The ROCE of the European cement industry over the recent business cycle

## 3.1 Global analysis

The results are given in table 5. Three calculations are presented: the first one is based on an average uniform unit capacity cost for all Europe, the second one on a differentiated unit capacity cost, and the third one further eliminates non EU imports and exports from consumption and capacity respectively.

It can be seen that while the geographical distinction affects the ROCE of each region it does not significantly affect the average ROCE. The elimination of non EU imports and exports does not significantly affect the results. It will be deleted.

A fourth calculation concerns the impact of the CO2 allowances, mostly significant over the period 2008-2012. Based on published company data, we have inferred the total net yearly revenues coming from the sale of CO2 allowances and subtracted it from the EBITDA. The results are given in table 5bis. The impacts on the EBITDA/sales and on the ROCE are quite important. This analysis suggests that the construction of a counterfactual of the firms' strategies in case these revenues did not occur would be an interesting exercise. No attempt to carry this exercise is done in the report.[11]

From this preliminary discussion we decide to carry our forthcoming analysis with keeping the geographical distinction between West and East, and the extra revenues from CO2 but without taking imports and exports into consideration.

The average ROCE at the European level is 5.3 % to be compared to a WACC of 9%. This means that the cash flow generated in the cement industry has not covered the expected or required return for the capital invested, suggesting that a strategic re-orientation or restructuring is required. The global statement remains true for Western Europe, the average ROCE is 4.3%, but not for Eastern Europe, for which the average profitability is 14.1%. Observe however that if we were to use the West cost of capacity for Eastern Europe one would get an average ROCE of 5.6% instead of 14.1% which questions the sustainability of the past Eastern profitability.

[11] The allowance mechanism may have induced some cement companies to keep under operation inefficient plants so as to continue to benefit from these allowances, which may have generated higher cost.

# Table 5: Yearly ROCEs and average ROCE values for Europe, Western and Eastern Europe

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **ROCE** | | | | | | | | | | |
| **Europe** | **5,9%** | **6,0%** | **8,3%** | **10,2%** | **9,5%** | **4,8%** | **2,4%** | **2,1%** | **0,4%** | ***5,4%*** |
| West | 6,3% | 6,2% | 8,3% | 9,6% | 7,9% | 4,5% | 2,2% | 1,7% | 0,1% | ***5,1%*** |
| East | 3,7% | 4,9% | 8,3% | 13,1% | 16,8% | 6,4% | 3,4% | 3,8% | 1,4% | ***6,7%*** |

With a uniform cost of assets of 165 €/t

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **ROCE** | | | | | | | | | | |
| **Europe** | **5,7%** | **5,8%** | **8,1%** | **10,0%** | **9,2%** | **4,7%** | **2,4%** | **2,0%** | **0,4%** | ***5,3%*** |
| West | 5,4% | 5,2% | 7,2% | 8,3% | 6,8% | 3,7% | 1,7% | 1,2% | -0,2% | ***4,3%*** |
| East | 8,9% | 11,0% | 16,8% | 25,2% | 31,6% | 13,7% | 8,5% | 9,0% | 5,0% | ***14,1%*** |

With differentiated cost of assets of 183 €/t for West and 95 €/t for East

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **ROCE** | | | | | | | | | | |
| **Europe** | **5,6%** | **5,8%** | **8,3%** | **10,3%** | **9,5%** | **4,7%** | **2,3%** | **2,2%** | **0,6%** | ***5,4%*** |
| West | 5,2% | 5,2% | 7,2% | 8,5% | 6,8% | 3,6% | 1,5% | 1,2% | 0,0% | ***4,3%*** |
| East | 8,9% | 11,0% | 16,8% | 25,2% | 31,6% | 13,7% | 8,5% | 9,0% | 5,0% | ***14,1%*** |

With differentiated cost of assets and import-export excluded

# Table 5bis: ROCE and Ebitda/sales without CO2, Western and Eastern Europe 2008-2012

| | | | 2008 | 2009 | 2010 | 2011 | 2112 |
|---|---|---|---|---|---|---|---|
| | ROCE | | | | | | |
| West | w CO2 | | 6,8% | 3,7% | 1,7% | 1,2% | -0,2% |
| | wo CO2 | | 5,6% | 2,3% | 0,0% | 0,2% | -0,6% |
| East | w CO2 | | 31,6% | 13,7% | 8,5% | 9,0% | 5,0% |
| | wo CO2 | | 29,1% | 10,8% | 5,4% | 6,9% | 3,8% |
| | | | | | | | |
| | EBITDA/sales | | | | | | |
| West | w CO2 | | 40,6% | 35,6% | 28,2% | 26,0% | 20,3% |
| | wo CO2 | | 35,4% | 27,9% | 18,3% | 20,2% | 16,6% |
| East | w CO2 | | 67,2% | 48,8% | 39,6% | 41,4% | 31,9% |
| | wo CO2 | | 62,3% | 40,6% | 29,5% | 34,4% | 27,2% |
| | | | | | | | |

### 3.2 ROCE as a function of unit margin and capital intensity

A standard textbook relationship relates the ROCE to the unit margin, EBITDA/Sales, times the capital intensity, Sales/CE. In our approach the capital employed (CE) is the capacity times the unit capacity cost, which is constant over time. So that the ratio Sales/CE can be expressed as the price of cement times the utilization rate.[12]

Graphs 2, 2bis and 2ter give the yearly ROCEs as function respectively of the yearly EBITDA/Sale, the yearly utilization rate and the yearly cement price. The correlations at the Europe level are good for the unit margin, not bad for the utilization rate and inexistent for the cement price. They are somewhat better at the regional levels than at the global EU level. However this static relationship is a pure accounting relationship that can be misleading since these three factors are interdependent.

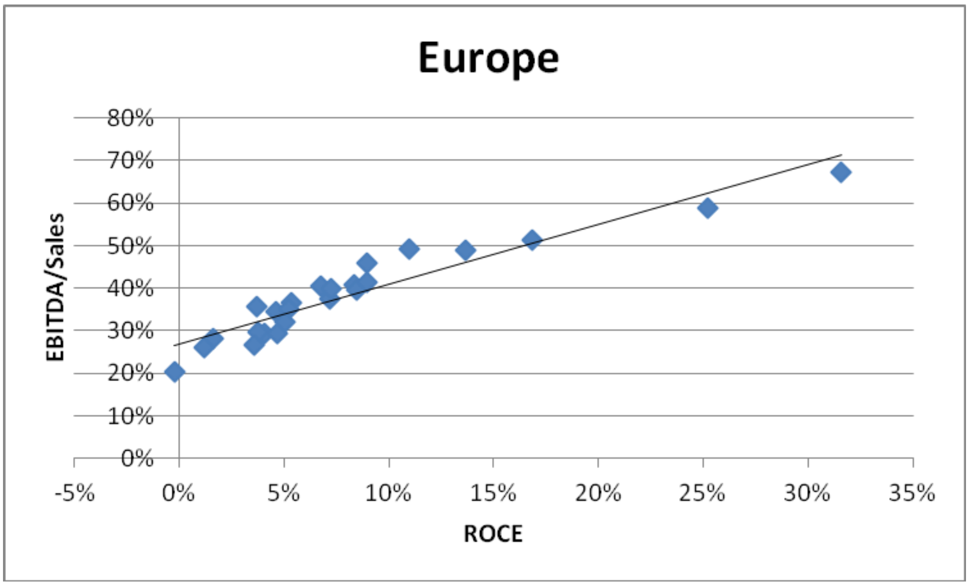
To get a first understanding of the interdependence of these factors we give in Table 6 the decomposition of the ROCE into the EBITDA/Sales and the capital intensity both for the expansion and the contraction phases. As one would expect from an economic perspective the business cycle has a joint major impact on the unit margin and the capital intensity, and so on the ROCE. The average profitability in Western Europe goes up from 4.3 % over the cycle to 6.6% in the expansion phase, and down to 2.6 % in the contraction phase. For Eastern Europe it goes from 14.6 % up to 19.8 %, and down to 8.9 % respectively.

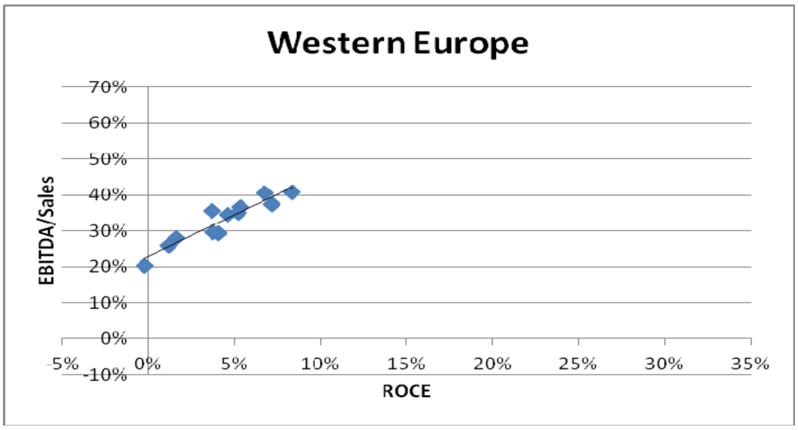
This analysis delivers two methodological conclusions: (i) EBITDA/Sales as such is a poor proxy measure of profitability, it need be completed by the capital intensity (ii) these two factors are interdependent and need be put in a proper time perspective to evaluate the profitability of the cement industry.

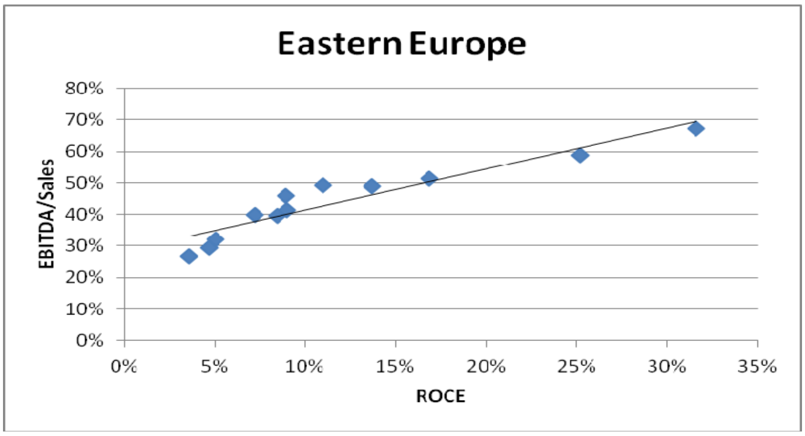
[12] At this level of analysis, production and consumption are very close (within 2% over this period according to CEMBUREAU statistics).

## Graph 2: EBITDA/Sales versus ROCE

sources Exane and authors calculations

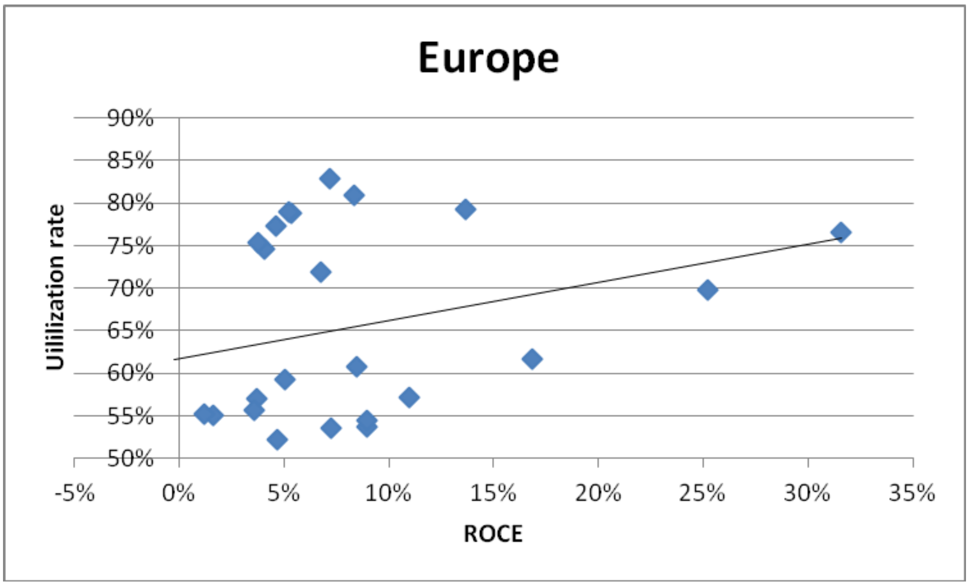


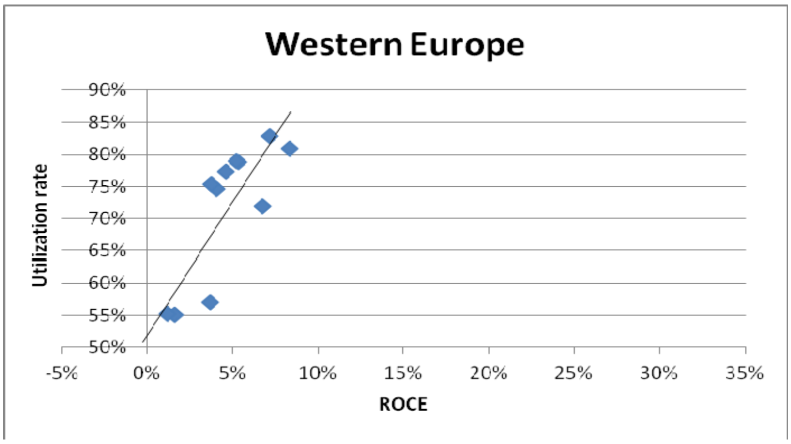



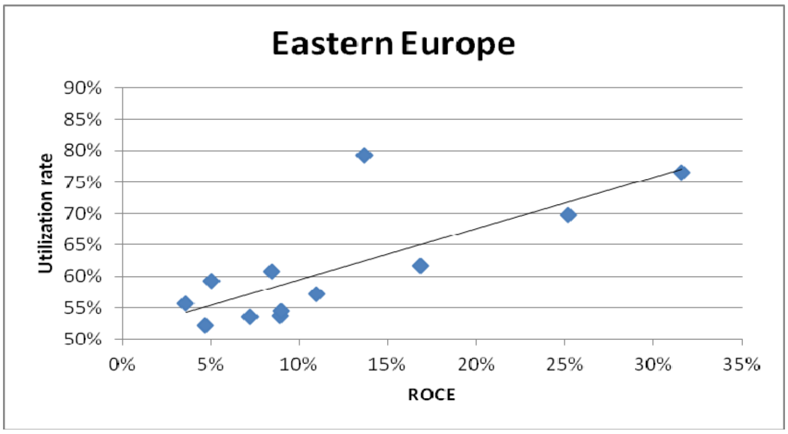



**Graph 2bis: Utilization rates versus ROCE**

sources Exane and authors calculations

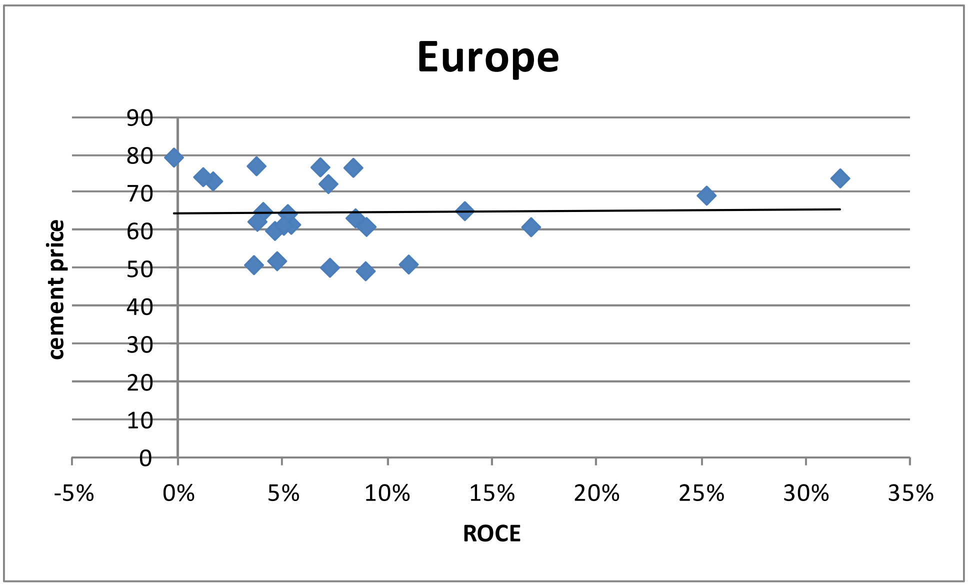


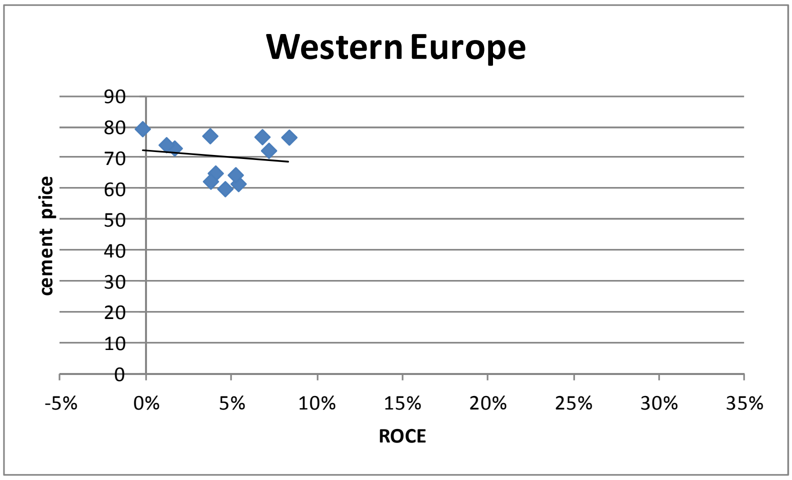



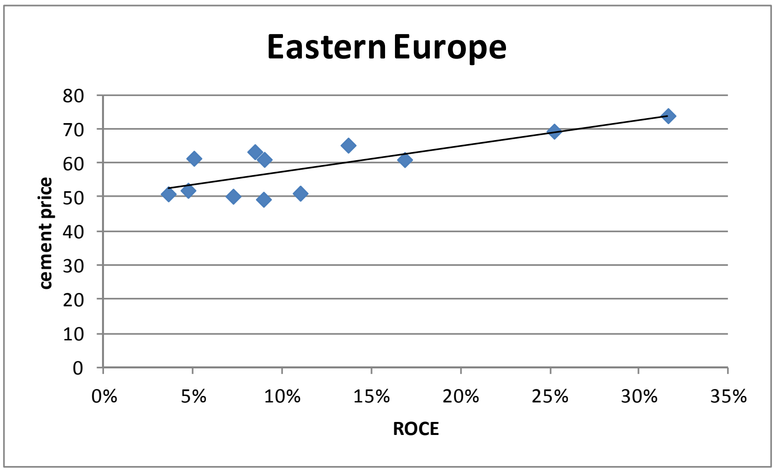



**Graph 2ter: cement price versus ROCE**

sources Exane and authors calculations



# Table 6: Decomposition of the ROCE by regions in EBITDA/Sales and Capital Employed/Sales

| Period | over the cycle | | expansion | | contraction | |
|---|---|---|---|---|---|---|
| Geographic area | West | East | West | East | West | East |
| years | 2004/2012 | 2005/2012 | 2004/2007 | 2005/2008 | 2008/2012 | 2008/2012 |
| ROCE | 4,3% | 14,6% | 6,6% | 19,8% | 2,6% | 8,9% |
| EBITDA/Sales | 33,4% | 48,5% | 37,5% | 55,0% | 30,1% | 40,4% |
| Capital employed/Sales | 3,47 | 2,19 | 2,91 | 1,87 | 4,02 | 2,24 |

### 3.3 Understanding the drivers of the ROCE

In this section we analyse the impact of the long term and short term factors that in our opinion mostly drive the evolution of the yearly ROCE. These factors are the capacity adaptation to demand and the associate rate of utilization on one hand, the price and the cost on the other hand. This will be important to infer how the strategy may impact the overall profitability of the industry.

#### 3.3.1 The capacity adaptation and the rate of utilization

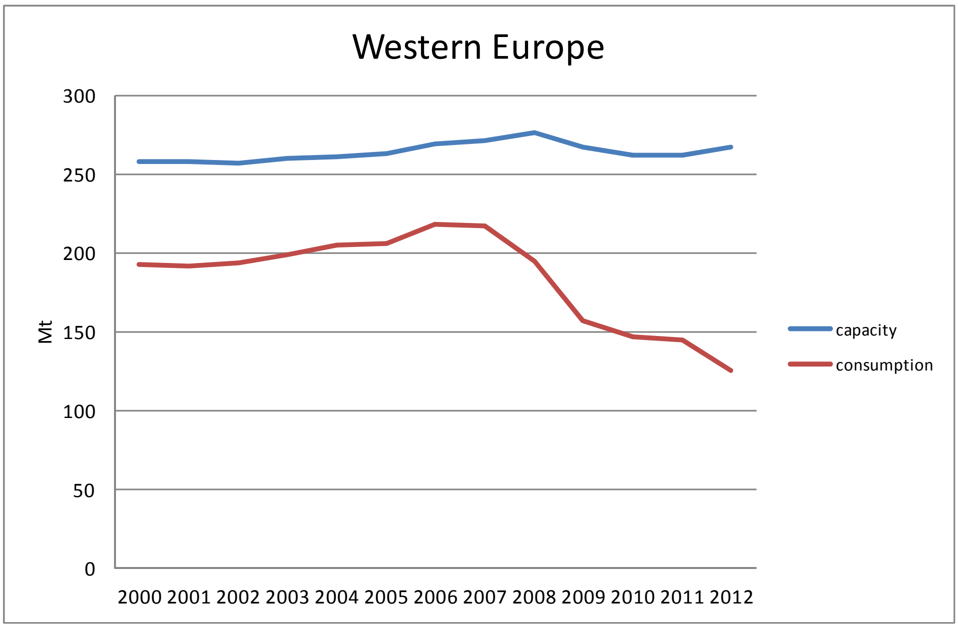
Graph 3 gives the consumption relative to the capacity net of non EU exports in both regions.

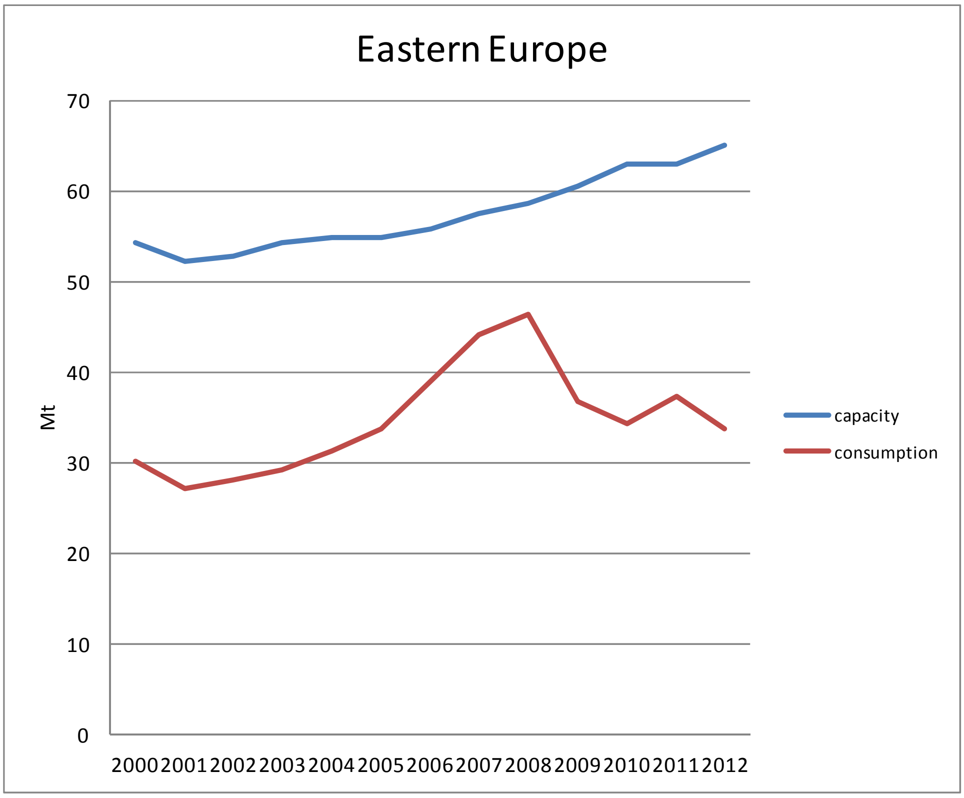
In Western Europe the expansion phase approximately corresponds to the years 2004-2007 while the contraction phase corresponds (so far) to the years 2007-2012. For Eastern Europe the expansion and contraction phases correspond to 2005-2008 and 2008-2012 respectively.

Over the whole period we can observe an average downward trend in consumption for West, and a moderate upward trend in East. The amplitude of the decline from the peak in West in 2007 to the current low in 2012 is 42 %, respectively 27 % in East from 2008 to 2012.

Comparatively speaking the capacity has been slow to adjust in both phases in both regions, generating a large excess capacity in the contraction phase.

## Graph 3: Consumption and capacities in Western and Eastern Europe



### 3.3.2 Price and cost

Graph 4 gives the price and cost evolution in both regions.

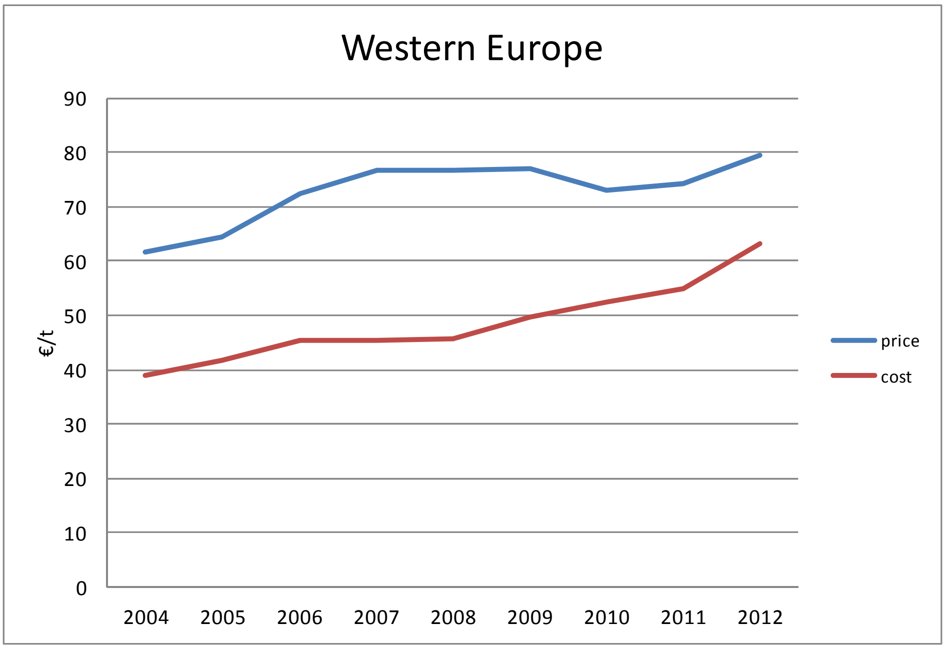
One would expect from economic theory that when demand varies the price would increase in an expansion phase and decline in a contraction phase. However this evolution has also to be seen in connection with the associated cost evolution both in Western and Eastern Europe.

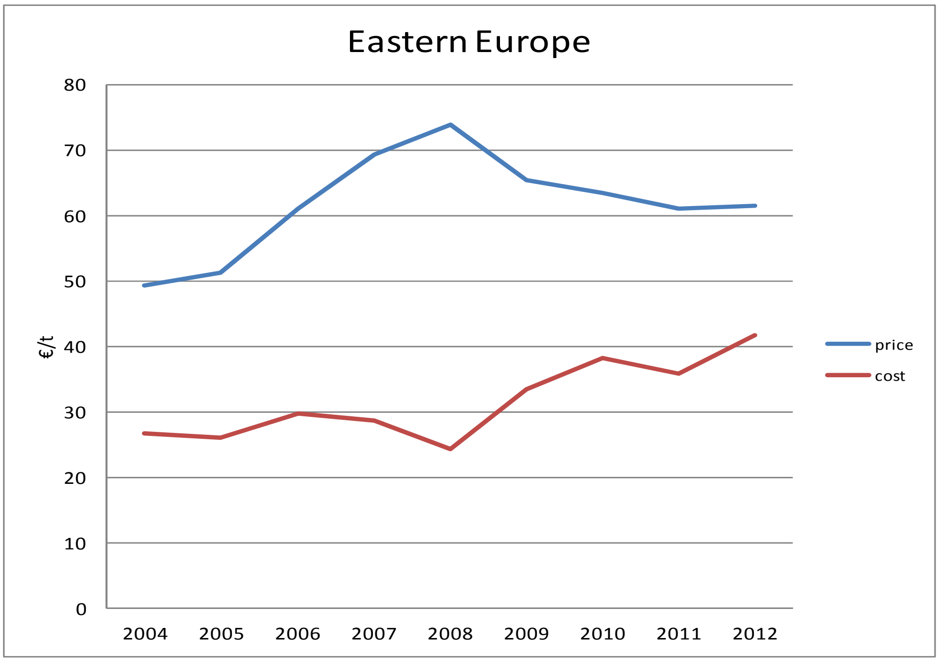
In this respect we observe that the cost in West is on an upward trend since 2004. Only in the recent years this upward trend has been observed in the East.

It is important to disentangle the structural reasons for these changes in cost which may partly reflect the differential rigidity of social rules as well as regulations, while energy costs have probably evolved in parallel in both regions.

Altogether the absolute profit margin (price – cost) has indeed increased in both regions during the peak period. In both regions the respective levels in 2012 have not recovered the 2004 levels.

## Graph 4: Prices and unit cost in Western and Eastern Europe



### 3.3.3 Quantification of each factor

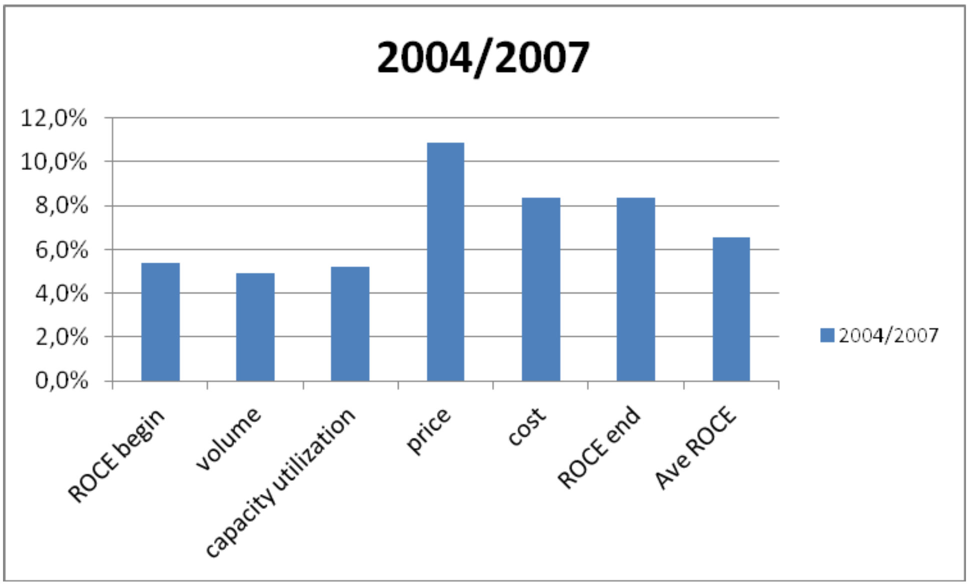
We now use a standard decomposition technique to quantify each factor, introducing each one sequentially and deriving the respective average ROCE changes that would result. This is done for Western and Eastern Europe separately.

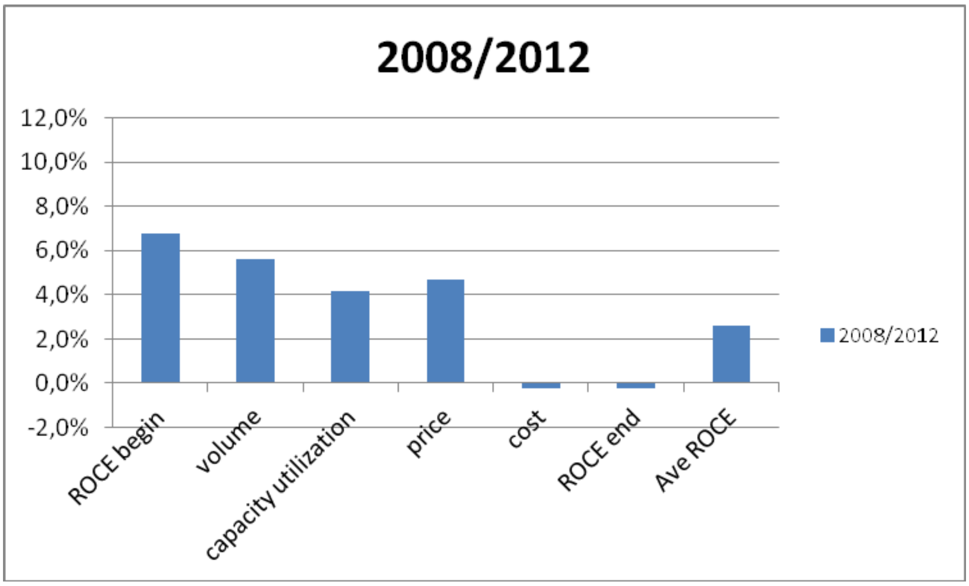
The results are depicted in graphs 5 and 6.

The analysis may be summarized as follows:

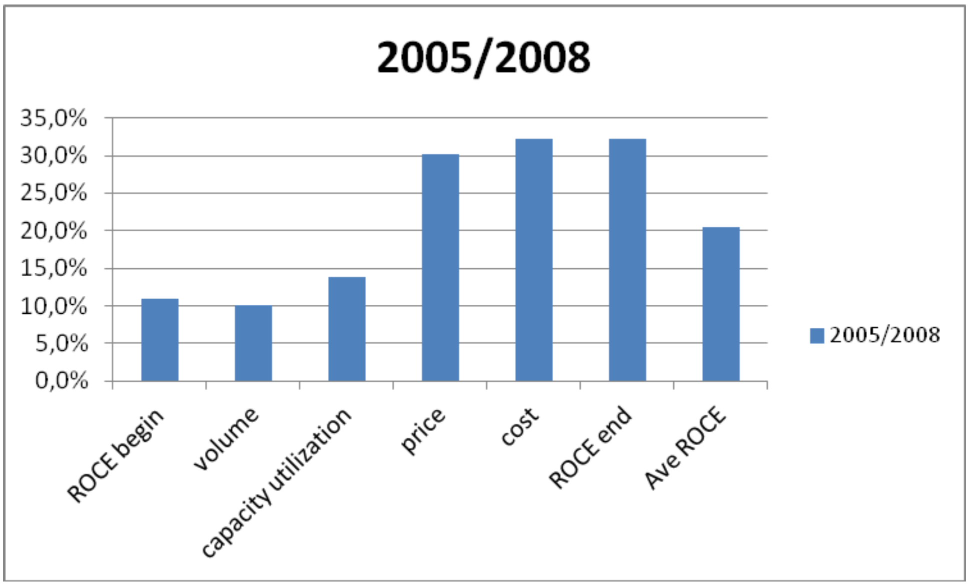
- ✓ In the expansion phase
    - Price changes play a major role to explain the increase in ROCE, this impact being somewhat mitigated in the West by the increase in cost.
- ✓ In the contraction phase
    - In the West the cost is the most important driver to explain the decrease in ROCE, volume and capacity utilization come second, while the price has a moderate positive influence
    - In the East all four factors contribute equally to the decline of the ROCE.

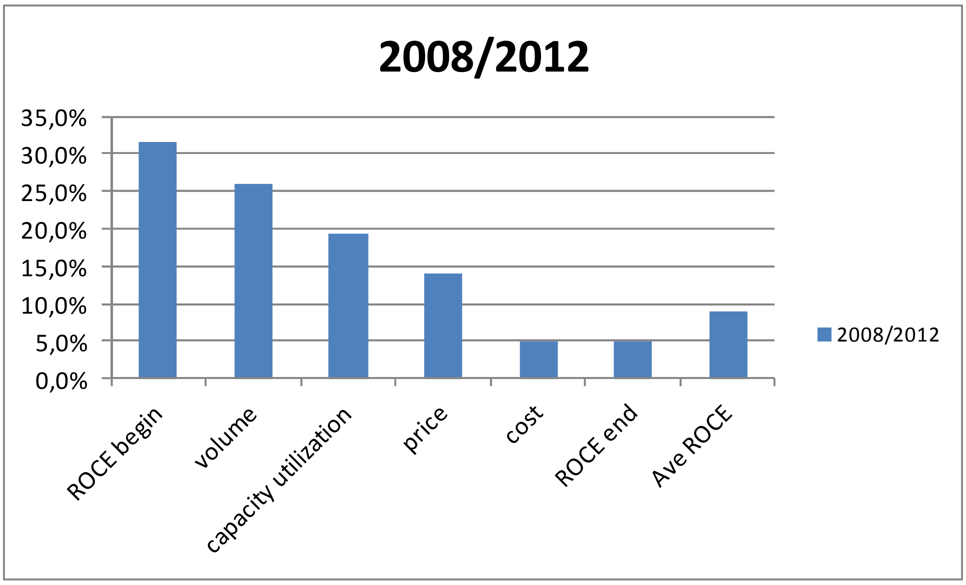
## Graph 5: The main drivers in Western Europe
### 2004-2007 and 2008-2011



## Graph 6: The main drivers in Eastern Europe
2005-2008 and 2008-2011



# 4 Implications for Part II of the study

This financial analysis provides the ground for the economic analysis to be elaborated in Part II. The economic analysis will rely on an explicit economic model rather than simple financial simulations as done in this report. We have identified a number of drivers to be incorporated.

We will need to step back from these drivers and introduce some structural factors. In particular we will introduce the role of market concentration on price and the impact of the price on import penetration. We also need to identify the conditions that may trigger investment and capacity adaptation over a business cycle.

We plan to make the analysis through two scenarios that would be representative of:

- A re-investment and profitable strategy based on the pursuit of the past networking strategy and leading to closing old plants + building new « best of class » plants + competitive advantage over imports.

- A lack of investment strategy to preserve cash flow in the midterm but leading to a declining European industry base relying more and more on imports.

## Scope of Part II study

This Part II report is the continuation of an ongoing research study on the profitability of the European cement industry.

In Part I we showed that the profitability level over the recent business cycle measured through the ROCE has always been below the weighted average cost of capital. This means that the cash flow generated by the cement activity did not cover the expected or required return for the invested capital.

This lack of profitability has put the European cement industry at risk.

Part II of the study seeks to identify the future conditions that may trigger investment and capacity adaptation over the next decades.

The analysis will be made through two broad scenarios that would be representative of:

- A lack of investment strategy to preserve cash flow in the midterm but leading to a declining European industry base relying more and more on imports.

- A re-investment and profitable strategy based on closing old plants + building new « best-in-class » plants + seeking competitive advantage over imports.

Important conditions for this analysis concern the environmental and competition policies that will prevail in Europe.

# 5 The economics of capital investment in the cement industry

## 5.1 The production of cement is local

The production of cement relies on clinker, which is produced through a continuous process in large kilns.

The main economic characteristics of the production are the following:

- The availability of large natural reserves of raw materials
- A mature technology
- A long life time for the plant

➔ The investment generates a large sunk cost with a predetermined capacity
➔ Operational costs depend on energy, qualified labour, logistics
➔ Flexibility after the investment is made is limited

## 5.2 The consumption of cement differs significantly from one region to another

Cement consumption is closely associated with the stage of development of the economy in the different countries.[13]

➔ The future growth of the cement market is in emerging countries.
➔ Europe is a mature market, which at best will enjoy very limited growth.

## 5.3 The nature of competition

Competition follows the standard dynamics of industry

- For growing markets: episodes of strong competition with multiple entries, simultaneous investment, pre-emption, price wars;
- For mature markets: consolidation moves, mergers, exits.

The specificity in the cement industry makes the pursuit of market share an important strategic consideration:

- For growing markets, single plant firms are at a disadvantage relative to multi-plant firms because of a lack of flexibility: the investment to follow the market can only be made at a relatively large scale which may generate temporary excess capacity;
- The ability to balance production within a networked set of plants gives some flexibility to hedge against regional volatility in the consumption of cement
- For mature markets, multi-plant firms have the ability to restructure their plants; they can adapt to the discontinuous changes in technological and managerial progress such as the introduction of the dry process, automation, economies of scale in operating large industrial plants...

➔ The regional concentration of the industry results from an "investment game" which may lie between two extreme outcomes
  - o Excessive entry leading to a fragmented industry
  - o Strategic dominance of multi-plant firms in which these firms have large market shares

➔ This market structure may still be affected after this investment game
  - o The construction of new plants from entrants is however unlikely
  - o The unilateral closing of plants is also unlikely because it would require an extreme price war to have negative cash flows
  - o Mergers and acquisitions would then be the most probable route through which the market structure would change

[13] Analysts' reports regularly give updates of world and regional market trends.

### 5.4 The regulatory context

Competition policy affects the strategy of firms in an environment characterized by horizontal concentration and vertical restraints, both of which can be seen as a way to limit ex-post competition and reduce the risk associated to the sunk cost feature of investments.

The geographical level at which the regulations are applied is a key issue. To precisely define the "relevant" market to assess what should be a "socially optimal" level of competition may be quite difficult because of the import and export flows from that market, which may vary over time.

The social welfare analysis is also complicated since it must take into account not only what should be the optimal "static" level of competition once the investment is made but also the optimal "dynamic" level, i.e. the retroactive influence of static competition on the investment strategies of firms.

Environmental regulations have affected the cement industry for decades: quarry operations, emissions of dust, dioxins, Mercury, Nitrogen Oxides... and more recently for CO2 emissions.

These regulations have indirect impacts on the investment cost, which may add to the capital intensity of the industry. Since the production of clinker generates large CO2 emissions the introduction of a CO2 price will directly impact the production cost. The differences in national regulations in this respect may significantly affect the competitive level playing field.

### 5.5 The financial markets and long term risk

The general idea that purely competitive market forces induce favourable conditions for long term investment is questionable. Financial markets may not always be efficient in providing proper instruments to hedge against long term risk.

Take the electricity sector. This sector is capital intensive and the delivery to the market generates significant distribution costs. Consider for instance the case of investment into renewable energies such as wind mills or photovoltaic. The direct operational cost of producing electricity is negligible, only the capital cost matters, it will be sunk for at least 20 years. These investments have been made possible only because of so called "feed-in tariffs", which allows a predictable future stream of revenues (and subsidies). The economic characteristics of this investment led to a temporary softening of competition policy.

This argument applies to some extent to the cement industry. The competition rules that will prevail after the (sunk) investment stage have a direct impact on the accessibility of firms to the financial markets, hence retroactively on their investment decisions.

# 6 Scenarios for the European cement industry

## 6.1 Preliminaries

We consider that the relevant market for our economic analysis is regional, allowing for regular inflows and outflows from this market.

The inter-regional flows structurally depend on the regional logistics through roads, rail and possibly access to deep water harbors, and the economic conditions prevailing in the importing and exporting regions. The actual flows may significantly differ from one region to another one and at any point of time. Cost structures may also vary significantly all through the various European markets.

This means that a precise assessment for Europe need be built from a consolidation of regional assessments (such as France, Germany, the Netherlands, Poland, Spain…). This is clearly out of the scope of this study. Our results should be considered as a first step in that direction. We provide a general methodology which can be used in a case by case basis for any specific relevant market, and discuss the results of numerical simulations that are representative of our current assessment of the European cement industry (Part I study).

## 6.2 The four scenarios

Two extreme views may be formulated regarding the future of the European cement industry over the next 10 to 15 years.

- The maturity of the cement demand is such that there is no need for future investments. Market forces should lead to the closing of inefficient plants and the price level should converge to the operational cost. The progressive decline of the cost positions of European plants relative to more modern plants in growing markets will lead to an increasing share of imports.

- There are opportunities for substantial cost improvements in spite of the maturity of the European market. These improvements could come from the closing of existing plants to increase the current low level of capacity utilization, a significant restructuring of the industrial base to concentrate production in large *best-in-class* plants. The current technology allows for very efficient plants that could produce several million tons per annum as it is now the case in emerging markets.

The current and future levels of the environmental and competition policies might influence the profitability of investments. The European emission trading scheme will influence the CO2 price and the allocation of emission permits. Investment costs may be indirectly affected by the stringency of the environmental policy. The competition policy may restrain merger and acquisition activity of the firms.

Altogether we shall analyze the following four scenarios.

a. **“No change”** or business as usual: i.e. the situation is more or less the one of the years 2010-2012; we assume no closing of plants, cost and price levels are unchanged.
b. **“Closing”** of old plants to restore a “satisfactory” level of the rate of utilization; fixed cost decreases, logistics cost increases, price decreases, a sunk cost has to be paid for closing plants (renovation of quarry, demolition of plant and social costs).
c. **“New plants”** that is restructuring to substitute new best-in-class large plants to old plants; operational cost decreases, logistics cost further increases, price decreases, a large sunk cost for closing plants has to be paid and an investment cost has to be paid for new plants.
d. **“Mergers”** and acquisition activities allowing further restructuring and cost synergies while increasing the market power of the industry.

Our main goal is to address the profitability question through deriving the internal rate of return of the following sequence:

- Going from No change to Closing
- Going from Closing to New plants
- Going from Closing to Mergers

The underlying rationale for looking at profitability in this way is that Closing is most certainly a profitable move so that No change cannot be the benchmark to assess the profitability of New plants; this scenario has to be assessed relative to Closing. New plants and Mergers are alternative that depend on the Competition authorities; both have to be assessed relative to Closing but Mergers may not be feasible.

The analysis of these four scenarios will be called the **Base case**. The analysis is carried out assuming essentially two stages:

- Stage 1: possibly re-investment inducing capital expenditures and respective cost changes;
- Stage 2: a steady state of cash flows over the future years, given the impact of stage 1 on the market (price, market size, import flows..).

All monetary values are in constant €; we consider that the associated weighted average cost of capital is 6%; it is based on 8% in current € (estimated for later periods in Part I report) and 2% inflation rate.

We introduce the same average tax rate as in in Part I that is, 23%.

A sensitivity analysis of the Base case will be made under three additional changes that will be introduced in sequence. These changes reflect more and more adverse conditions for the industry:

- “imports vulnerability” An increase of the competitiveness of European imports as the cost structure of importing plants goes frombase case to imports vulnerability as defined in section 3.3
- “imports vulnerability and a CO2 price” without free allocations
- “imports vulnerability and a CO2 price and a stringent environmental regulation” that further leads to additional investment costs for new and old plants.

The role of the competitive regulation is assessed at all times through the scenario “Mergers”.

### 6.3 The cost assumptions for the scenarios

We detail the plant characteristics assumed for each scenario. Then we introduce our assumptions regarding the capital expenditures, the cash costs, and finally the CO2 cost. All the figures are our own best estimates based on analysts' reports and industry sources.

| | | | Europe | | | Best plant world | |
|---|---|---|---|---|---|---|---|
| | | unit | no change | closing | & new plants | base case | import vulnerability |
| Plant characteristics | clinker capacity (K=clinker) | kt | 500 | 500 | 1 500 | 1 500 | 2 200 |
| | cement/clinker ratio | | **1,30** | **1,30** | **1,50** | **1,50** | **1,50** |
| | utilization rate | % | **56%** | **70%** | **70%** | **70%** | **85%** |

The introduction of new plants is seen as the substitution of "three" old plants of 500 kt clinker capacity for one new plant of 1500 kt capacity. Two additional assumptions are made: an increase in the cement/clinker ratio and an increase in the utilization rate, up to a target from the current average rate of 56% in case of "no change". These rates are important in two ways: they have an impact on the fixed costs per unit of cement production and an impact on the sustaining capex which are calculated as a percentage of the cost capital of the capacity required for producing one ton of cement.

The building of new plants generates capital expenditures. We assume that new plants are brown field plants so that the capital cost is taken at 160 € per ton of cement capacity, which is lower than the figures for green field plants usually found in analysts' reports. The closing of old plants generates "closing costs" for site renovation and social expenditures. We estimate the closing cost at 20€/t (of which 80% is estimated to come from social cost). These costs are introduced as capital expenditures taking into account the tax rebates, they do not appear in the cash flows.

The cash costs are summarized in the next table. They have been constructed through a detailed analysis of five components:[14]

- Energy costs (heat and power consumptions and respective prices)
- Material costs (raw material and other consumables)
- Fixed costs (number of employees, average wage, other costs)
- Logistics (plant to market)
- Sustaining capex

[14] This detailed analysis is not reproduced here.

| Cash cost | | unit | Europe no change | Europe closing | Europe & new plants | Best plant world base case | Best plant world import vulnerability |
|---|---|---|---|---|---|---|---|
| Energy costs | total | €/t | 15,4 | 15,4 | 10,7 | 10,7 | 3,7 |
| Material costs | Raw Materials and other cons | €/t | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 |
| Fixed costs | per unit | €/t | 23,8 | 19,1 | 8,1 | 8,1 | 3,0 |
| Logistics | plant or terminal to market | €/t | 5,0 | 6,0 | 8,0 | 8,0 | 8,0 |
| Sustaining capex | annual sus | €/t | **12,9** | 10,3 | **4,6** | **3,4** | **2,8** |
| Cash cost | incl sus capex | €/t | **67,1** | **60,8** | **41,4** | **40,2** | **27,5** |

Several points need be noted:

- The higher energy efficiency of new plants and on top of that the lower energy prices for import vulnerability.
- Similarly, new plants generates much lower fixed costs, and a further decline for import vulnerability.
- On the other hand the restructuring induces an increase in logistics.
- The decrease in sustaining capex comes from the high percentage rate for old plants (estimated at 4% in Part I) while we assume 2% for new plants.

We shall assume that in case of mergers cost synergies would reduce the cash cost of New plants by 10%, a factor that would need to be further documented.

### 3.4 Additional assumptions for the sensitivity analysis

Competition between domestic producers and importers is formalized through the introduction of an import competitive fringe. The level of imports is determined by the difference between the cement price and a threshold price (cash cost of importing plants plus a transport cost) multiplied by an import supply factor. We have estimated this import supply curve for the no change scenario. [15]

The imports vulnerability sensitivity analysis simply amounts to changing the cash costs according to the assumptions detailed in the section 3.3 from the base case to the imports vulnerability.

[15] This follows the standard economic modeling practice in the cement literature (see appendix 4). It is also consistent with the recent observations of the UK on cement imports http://www.competition-commission.org.uk/assets/competitioncommission/docs/2012/aggregates-cement-and-ready-mix-concrete/cement_imports.pdf
This assumption does not take into account the potential threat of imports, and the possible use of limit price by domestic producers to strategically limit entry. These considerations would certainly be worth introducing in future work.

Our estimates of the emission factor $tCO_2$/tclinker are based on the current estimates reported in the Cement Sustainability Initiative CSI.[16] We do not assume much efficiency gains over the next 10-15 years on top of the gains associated to the increase of the cement/clinker ratio, which is already embedded in our calculations (for instance we exclude carbon capture and sequestration).

| | | | Europe | | | Best plant world | |
|---|---|---|---|---|---|---|---|
| **CO2** | | unit | no change | closing | & new plants | base case | import vulnerability |
| CO2 | emission rate | tCO2/tK | 0,862 | 0,862 | 0,766 | 0,720 | 0,720 |

The $CO_2$ price sensitivity analysis amounts to introducing a $CO_2$ price at 20€/t, which is high relative to the record low levels observed in 2013, but remains moderate in the medium term, as long as climate change remains on the EU agenda. Recall that we assume no free allocations, so that the introduction of a $CO_2$ price directly leads to an increase of the cash cost through the cost of emission permits.

The sensitivity analysis associated to a stringent environmental policy will further induce an increase in the investment cost of new plants that we estimate at 15% of the initial capex, and twice this amount for old plants. It is important to note that these expenditures are assumed to be proportional to the capacity installed and not to the actual production.

## 4. The profitability of the different scenarios.

We proceed in four steps:

- A change in cash cost induces a change in the cement market price, which allows the calculation of the ebitda/sales for each scenario
- Using the capital cost we get the ROCE for each scenario
- We now introduce the induced changes in the market size, and its split between domestic production and imports
- Finally we derive the internal rate of return associated with moving from one scenario to another one, giving due account to the market changes.

### 4.1. Prices and Ebitda/sales

16 www.wbcsdcement.org

The decrease in the cash cost as one goes from one scenario to another one is partly passed to the market price. The pass through rate depends on the level of competition in the market: the lower the lower the level of competition.[17]

With our assumption the rate is about 86% in the two scenarios closing and new plants, it drops to approximately 60% in case of mergers.

The associated Ebitda/sales are given in the next table. Recall that the Ebitda is without sustaining capex, this explains the slight increase for the sensitivity analysis stringent environment.

| **ebitda/sales** | | no change | closing | new plants | & mergers |
|---|---|---|---|---|---|
| base case | | 33% | 33% | 37% | 49% |
| Imports vulnerability | | 33% | 33% | 37% | 49% |
| & CO2 at 20€/t | | 27% | 26% | 30% | 41% |
| & stringent environment | | 29% | 28% | 31% | 41% |

**4.2 ROCE**

We use the same methodology as in Part I to obtain the ROCE associated with the different scenarios (i.e. the capital is computed as the unit cost of capacity times the capacity to produce 1 ton of cement, for old plants the unit cost of capacity was estimated to be 180€/t).

Table ** gives the different values. Since the weighted average cost of capital (in constant money) has been estimated at 6% this shows that only the scenario mergers would generate an appropriate rate of return. This rate of return would decrease as the environment deteriorates but would remain higher than the wacc.

| **ROCE** | | no change | closing | new plants | & mergers |
|---|---|---|---|---|---|
| base case | | 3,3% | 4,4% | 5,9% | 10,9% |
| Imports vulnerability | | 3,2% | 4,3% | 5,7% | 10,7% |
| & CO2 at 20€/t | | 2,8% | 3,8% | 5,3% | 10,0% |
| & stringent environment | | 2,1% | 2,9% | 4,5% | 8,6% |

[17] It would be 100% in a sector operating under perfect competition.

### 4.3. Market size, domestic production and imports

The ROCE profitability measure is done for 1 ton of sale. However the cash cost changes also induce changes into the prices which in turn induce changes in the size of the market.

A key parameter in this process is the price elasticity of the demand. Our own estimate ranges between -.7 to -.9.[18]

The market sizes associated to the different scenarios is reported in the next table. Two effects are combined: the cost decrease due to the higher efficiency of new plants and the cost increase due to the $CO_2$ price.

| **market size** | | no change | closing | new plants | & mergers |
|---|---|---|---|---|---|
| base case | | 1,00 | 1,05 | 1,19 | 1,16 |
| Imports vulnerability | | 1,00 | 1,05 | 1,19 | 1,16 |
| & CO2 at 20€/t | | 0,91 | 0,95 | 1,12 | 1,10 |
| & stringent environement | | 0,88 | 0,93 | 1,11 | 1,10 |

The market is sourced from domestic plants and imports, the relative competitiveness of the two sources varies from one scenario to the other. The market shares are reported in the next table. The construction of new plants provides a significant improvement of the competitiveness of domestic production, even in a stringent environment.

[18] Elasticity estimation requires sophisticated econometric techniques. We directly use an estimate which is in line with the ranges used in the literature, for a discussion of this point see for instance Meunier, Ponssard and Quirion, 2012.

| % domestic production | | no change | closing | new plants | & mergers |
|---|---|---|---|---|---|
| base case | | 95% | 96% | 100% | 100% |
| Imports vulnerability | | 92% | 94% | 98% | 97% |
| & CO2 at 20€/t | | 88% | 90% | 96% | 95% |
| & stringent environment | | 87% | 89% | 96% | 95% |
| | | | | | |
| **% imports** | | no change | closing | new plants | & mergers |
| base case | | 5% | 4% | 0% | 0% |
| Imports vulnerability | | 8% | 6% | 2% | 3% |
| & CO2 at 20€/t | | 12% | 10% | 4% | 5% |
| & stringent environment | | 13% | 11% | 4% | 5% |

## 4.4. Internal rate of return associated to going from one scenario to another one

We are now in a position to assess the profitability of going from one scenario to another one. Recall that this assessment is made assuming the following sequence:

- Going from No change to Closing
- Going from Closing to New plants
- Going from Closing to Mergers.

The internal rates of return associated with this sequence are reported in the next table.

| IRR (%) | | no change | closing | new plants | & mergers |
|---|---|---|---|---|---|
| base case | | | 38,6% | 3,1% | 7,2% |
| Imports vulnerability | | | 38,9% | 3,1% | 7,2% |
| & CO2 at 20€/t | | | 41,0% | 3,3% | 7,3% |
| & stringent environment | | | NA | 3,8% | 8,8% |

This analysis confirms the intuition that the benefit of Closing is clear: the increase in the utilization rate not only reduces the fixed cost but also drastically reduces the sustaining capex. In case of a stringent environment the scenario Mergers even reduces the closing cost relative to Closing, because of the increase in domestic production, this explains the NA in the Table.

However, once this move has been implemented, the profitability of New plants is lower than the wacc.

A satisfactory level of profitability is only achieved under the scenario Mergers.

## 5. Conclusions

Three conclusions emerge from this analysis:

- ✓ Closing is always an extremely profitable move but this move may not be enough to maintain the intrinsic profitability of the European industry (the ROCE remains below the wacc) and the competitiveness of the industry remains at risk (imports would increase from 5% to 12-13% in our worst environmental sensitivity analysis).

- ✓ Once Closing is carried on, New plants would restore significantly the competitiveness of the industry but it is not a profitable move.

- ✓ Mergers both restores significantly the competitiveness of the industry and is a profitable move. Though this scenario is based on an increase of market concentration, the price level would remain lower than the one associated to Closing. It would also put the industry in a sustainable intrinsic profitability state (ROCE higher than the wacc).

These analyses are illustrative of what our methodology can deliver. This methodology can be used on a case by case basis, with assumptions calibrated on the relevant market to be studied. Policy conclusions would be reassessed accordingly.

# 6. Appendices

## 6.4 Appendix 1 : Cost data and detailed financial results

| | | | | Europe | | | | Best plant world | |
|---|---|---|---|---|---|---|---|---|---|
| **Cost structure** | | unit | notation or calculation | no change | closing | & new plants | & mergers | base case | import vulnerability |
| Plant characteristics | clinker capacity (K=clinker) | kt | | 500 | 500 | 1 500 | 1 500 | 1 500 | 2 200 |
| | cement/clinker ratio | | ck | **1,30** | **1,30** | **1,50** | **1,50** | **1,50** | **1,50** |
| | utilization rate | % | ur | **56%** | **70%** | **70%** | **85%** | **70%** | **85%** |
| | cement cap for 1 cement sa | t | =1/ur | **1,79** | **1,43** | **1,43** | **1,18** | **1,43** | **1,18** |
| Energy costs | total | €/t | | 15,4 | 15,4 | 10,7 | 10,7 | 10,68 | 3,7 |
| Material costs | Raw Materials and other cor | €/t | | 10,0 | 10,0 | 10,0 | 10,0 | 10,00 | 10,0 |
| Fixed costs | per unit | €/t | | **24** | **19** | **8** | **7** | **8** | **3** |
| Logistics | plant or terminal to market | €/t | | **5,0** | **6,0** | **8,0** | 8,00 | **8,0** | **8,0** |
| Sustaining capex | book value | €/t | B | 60 | 60 | 160 | 160 | 120 | 120 |
| | adjusted book value | €/t | AB | 180 | 180 | 160 | 160 | | |
| | annual sus (%adjbook) | % | | **4%** | 4% | **2%** | 2% | **2%** | 2% |
| | annual sus | | =%AB/ur | **12,9** | 10,3 | **4,6** | 3,8 | **3,4** | **2,8** |
| $CO_2$ | $CO_2$ emissions | $tCO_2/tK$ | em | 0,862 | 0,862 | 0,766 | 0,766 | 0,720 | 0,720 |
| | **carbon price** | €/t $CO_2$ | carbon | **0** | **0** | **0** | **0** | **-** | **-** |
| | cost of $CO_2$ permits | €/t | =emcarbon/ck | **0,00** | **0,00** | **0,00** | **0,00** | | |
| Cash cost | incl sus capex & $CO_2$ | €/t | | **67,1** | **60,8** | **41,4** | **35,2** | **40,2** | **27,5** |
| Invest capex | **Capex new plants** | €/t | | **0** | **0** | **160** | **160** | **120** | |
| | **env capex old and new** | €/t | | **0** | **0** | **0** | **0** | | |
| | | | | | | | | | |
| **additional assumptions** | | | | | | | | | |
| | cost synergy w mergers | % | =% cash cost | | | | 10% | | |
| | closing cost old plants | €/t | Cc | | 20 | 20 | 20 | | |
| | tax rate | | $\tau$ | 23% | | | | | |
| | wacc | | | 6% | | | | | |

| **Results** | base case | | | |
|---|---|---|---|---|
| **Profitability analysis** | no change | closing | new plants | & mergers |
| unit price | 81 | 76 | 59 | 62 |
| cash cost (incl sus capex) | 67,1 | 60,8 | 41,4 | 35,2 |
| ebitda/sales | 33% | 33% | 37% | 49% |
| utilization rate | 56% | 70% | 70% | 85% |
| cement cap for 1 cement sale | 1,8 | 1,4 | 1,4 | 1,2 |
| book value 1t cap | 60 | 60 | 160 | 160 |
| inv in new plants (wo env) | 0 | 0 | 160 | 160 |
| adjusted book value | 180 | 180 | 160 | 160 |
| depreciation on book (with wacc) | 6,43 | 5,14 | 13,71 | 11,29 |
| sus capex on (%) adj book value | 12,86 | 10,29 | 4,57 | 3,76 |
| free cash flow (after tax) | 9,20 | 10,16 | 15,48 | 22,32 |
| consumption | 1,00 | 1,05 | 1,19 | 1,16 |
| dom prod | 0,95 | 1,01 | 1,19 | 1,16 |
| import | 0,05 | 0,04 | 0,00 | 0,00 |
| import % | 5% | 4% | 0% | 0% |
| adjusted capacity for dom prod | 1,70 | 1,44 | 1,70 | 1,36 |
| capex (closing) | | 3,92 | -3,99 | 1,26 |
| new capex (incl envir) | 0,00 | 0,00 | 272,07 | 217,53 |
| total capex | 0,00 | 3,92 | 268,08 | 218,79 |
| free cash flow | 8,74 | 10,26 | 18,43 | 25,80 |
| net free cash flow | | 1,51 | 8,18 | 15,54 |
| IRR | | 38,6% | 3,1% | 7,2% |
| ROCE | 3,3% | 4,4% | 5,9% | 10,9% |
| EVA | -8,18 | -4,12 | -0,40 | 10,74 |
| Delta EVA | | 4,05 | 3,72 | 14,87 |

| **Results** | Imports vulnerability | | | |
|---|---|---|---|---|
| Profitability analysis | no change | closing | new plants | & mergers |
| unit price | 81 | 75 | 58 | 61 |
| cash cost (incl sus capex) | 67,1 | 60,8 | 41,4 | 35,2 |
| ebitda/sales | 33% | 33% | 37% | 49% |
| utilization rate | 56% | 70% | 70% | 85% |
| cement cap for 1 cement sale | 1,8 | 1,4 | 1,4 | 1,2 |
| book value 1t cap | 60 | 60 | 160 | 160 |
| inv in new plants (wo env) | 0 | 0 | 160 | 160 |
| adjusted book value | 180 | 180 | 160 | 160 |
| depreciation on book (with wacc) | 6,43 | 5,14 | 13,71 | 11,29 |
| sus capex on (%) adj book value | 12,86 | 10,29 | 4,57 | 3,76 |
| free cash flow (after tax) | 8,90 | 9,87 | 15,19 | 21,89 |
| consumption | 1,00 | 1,05 | 1,19 | 1,16 |
| dom prod | 0,92 | 0,98 | 1,16 | 1,13 |
| import | 0,08 | 0,07 | 0,03 | 0,03 |
| import % | 8% | 6% | 2% | 3% |
| adjusted capacity for dom prod | 1,65 | 1,40 | 1,66 | 1,33 |
| capex (closing) | | 3,78 | -3,99 | 1,13 |
| new capex (incl envir) | 0,00 | 0,00 | 266,02 | 212,92 |
| total capex | 0,00 | 3,78 | 262,04 | 214,04 |
| free cash flow | 8,22 | 9,69 | 17,68 | 24,76 |
| net free cash flow | | 1,47 | 7,98 | 15,06 |
| IRR | | 38,9% | 3,1% | 7,2% |
| ROCE | 3,2% | 4,3% | 5,7% | 10,7% |
| EVA | -8,22 | -4,30 | -0,73 | 10,02 |
| Delta EVA | | 3,92 | 3,57 | 14,33 |

| **Results** | Imports vulnerability & CO2 at 20€/t | | | |
|---|---|---|---|---|
| Profitability analysis | no change | closing | new plants | & mergers |
| unit price | 92 | 87 | 67 | 69 |
| cash cost (incl sus capex) | 80,4 | 74,1 | 51,6 | 44,4 |
| ebitda/sales | 27% | 26% | 30% | 41% |
| utilization rate | 56% | 70% | 70% | 85% |
| cement cap for 1 cement sale | 1,8 | 1,4 | 1,4 | 1,2 |
| book value 1t cap | 60 | 60 | 160 | 160 |
| inv in new plants (wo env) | 0 | 0 | 160 | 160 |
| adjusted book value | 180 | 180 | 160 | 160 |
| depreciation on book (with wacc) | 6,43 | 5,14 | 13,71 | 11,29 |
| sus capex on (%) adj book value | 12,86 | 10,29 | 4,57 | 3,76 |
| free cash flow (after tax) | 7,51 | 8,47 | 14,12 | 20,47 |
| consumption | 0,91 | 0,95 | 1,12 | 1,10 |
| dom prod | 0,80 | 0,86 | 1,07 | 1,05 |
| import | 0,11 | 0,09 | 0,05 | 0,05 |
| import % | 12% | 10% | 4% | 5% |
| adjusted capacity for dom prod | 1,43 | 1,23 | 1,53 | 1,24 |
| capex (closing) | | 3,10 | -4,61 | -0,16 |
| new capex (incl envir) | 0,00 | 0,00 | 244,24 | 197,96 |
| total capex | 0,00 | 3,10 | 239,63 | 197,81 |
| free cash flow | 6,01 | 7,28 | 15,08 | 21,53 |
| net free cash flow | | 1,27 | 7,80 | 14,25 |
| IRR | | 41,0% | 3,3% | 7,3% |
| ROCE | 2,8% | 3,8% | 5,3% | 10,0% |
| EVA | -8,23 | -4,96 | -1,82 | 7,83 |
| Delta EVA | | 3,28 | 3,14 | 12,79 |

| **Results** | Imports vulnerability & CO2 at 20€/t & Stringent Env | | | |
|---|---|---|---|---|
| Profitability analysis | no change | closing | new plants | & mergers |
| unit price | 93 | 86 | 64 | 69 |
| cash cost (incl sus capex) | 83,8 | 76,8 | 52,3 | 44,9 |
| ebitda/sales | 27% | 26% | 27% | 41% |
| utilization rate | 56% | 70% | 70% | 85% |
| cement cap for 1 cement sale | 1,8 | 1,4 | 1,4 | 1,2 |
| book value 1t cap | 60 | 60 | 184 | 184 |
| inv in new plants (wo env) | 0 | 0 | 160 | 160 |
| adjusted book value | 228 | 228 | 184 | 184 |
| depreciation on book (with wacc) | 11,57 | 9,26 | 15,77 | 12,99 |
| sus capex on (%) adj book value | 16,29 | 13,03 | 5,26 | 4,33 |
| free cash flow (after tax) | 5,64 | 6,43 | 11,72 | 20,65 |
| consumption | 0,90 | 0,96 | 1,14 | 1,10 |
| dom prod | 0,79 | 0,86 | 1,10 | 1,05 |
| import | 0,11 | 0,09 | 0,04 | 0,05 |
| import % | 12% | 10% | 4% | 5% |
| adjusted capacity for dom prod | 1,42 | 1,23 | 1,57 | 1,23 |
| capex (closing) | | 2,88 | -5,21 | 0,00 |
| new capex (incl envir) | 68,11 | 59,14 | 288,92 | 226,71 |
| total capex | 68,11 | 62,01 | 283,71 | 226,71 |
| free cash flow | 4,48 | 5,55 | 12,88 | 21,63 |
| net free cash flow | | 1,06 | 7,34 | 16,08 |
| IRR | | NA | 3,3% | 9,8% |
| ROCE | 1,7% | 2,2% | 3,5% | 8,6% |
| EVA | -14,07 | -10,56 | -7,11 | 5,94 |
| Delta EVA | | 3,51 | 3,45 | 16,50 |

## 6.5 Appendix 2: The economic model of competition

Our simulations are based on a Cournot model with a linear demand function and a constant unit cost, denoted as c.

We introduce a competitive fringe for imports, using a linear supply curve.

Let the demand function be

$$P = a - bQ$$

Importers take the market price as given; the level of imports $Q_i$ is determined by a linear supply curve

$$Q_i = m\,(P - P_i°)$$

in which m and P° are two exogenous parameters.

Let $Q_d$ stand for the domestic production; since Q is $Q_d + Q_i$ it is a simple matter to derive the linear demand curve for the domestic production

$$P = a^* - b^*\,Q_d$$

We assume that the level of competition is exogenous and can be characterized by the Herfindhal index (H). If n represents the number of symmetric firms in the market, H=10000/n .

Using the Cournot competition model one gets

$$P = (a^* + nc)/(n+1)$$

We calibrate the “no change” case to reflect the situation of the industry in 2012 (see Table 1).

The “observed” data are estimates based on Part I of the study. The values are representative of a geographical area with moderate competition and moderate exposure to trade. The level consumption is taken at 1 by convention. This will not impact relative profitability measures (IRR, ROCE), while absolute measures (EVA) will have to be multiplied by the actual level of demand in the case under study.

A scenario induces a change in the cost parameters. The model is used to infer the impacts in terms of price and market size (see Table 2). Appendix 3 gives the impacts in terms of profitability measures.

**Table 1 Calibration of the model**

| | | | |
|---|---|---|---|
| Calibration of the Cournot model | | | Base case |
| Cost parameters | | | |
| | Domestic cost | c | 67,1 |
| | Import threshold price | Pi° | 60,2 |
| "Observed" data | | | |
| | Market price | P° | 81 |
| | Consumption (normalized) | Q° | 1,00 |
| | Local elasticity | e | 0,7 |
| | Imports % | i° | 5% |
| Calibrated parameters | | | |
| | Slope of import supply curve | m = i°Q°/(P° - Pi°) | 0,002 |
| | Slope of total demand | b = P°/eQ° | 119 |
| | Intercept of total demand | a = P° + bQ° | 200 |
| | Slope of domestic demand | b* = b / (1+mb) | 93 |
| | Intercept of domestic demand | a* = P° + b*Q°(1 – i°) = (a + mbPi°) / (1 + mb) | 169 |
| | Local domestic elasticity | e* = e (1 + mb)/(1 – i°) | 0,9 |
| | Number of Cournot competitors | n = (a* - P°) / (P° - c) | 6,34 |

**Table 2 Using the model to simulate a scenario**

| | | | |
|---|---|---|---|
| Simulation of  a scenario | | | |
| Fixed parameters | | | |
| | Slope of domestic demand | b* | 93 |
| | Intercept of domestic demand | a* | 169 |
| | Slope of import supply curve | m | 0,002 |
| Parameters depending on the scenario | | | |
| | Domestic cost | c | |
| | Import threshold price | Pi° | |
| | Number of Cournot competitors | n | |
| Outputs of the model | | | |
| | Market price | (a*+nc)/(n+1) | |
| | Domestic production | Qd=[n(a*-c)]/[b*(n+1)] | |
| | Imports | Qi=Max[0;m*(P-Pi°)] | |
| | Consumption | Q=Qd+Qi | |
| | Imports % | i=Qi/Q | |

## 6.6 Appendix 3: Formulation of the financial performance measures

We start with the "no change" situation. A scenario involves a change in unit cost and a capital expenditure through:

- Defining a target for the utilization rate
- Closing of some old plants which generates closing costs
- Building of new plants as brown field plants in substitution of the remaining old plants (no closing costs are assumed for these "restructured" old plants)

New plants are more efficient than old plants; part of the cost decrease is passed through to the consumers in the unit market price; this leads to an increase in domestic production due to two factors: a larger domestic market due to price elasticity and a higher market share of domestic producers relative to imports.

The profitability analysis takes all these effects into account.

We normalize the size of the market to 1 unit (1t of cement). This market is served by domestic production and imports. The normalization will not impact relative profitability measures (IRR, ROCE), while absolute measures (EVA) will have to be multiplied by the actual level of demand in the case under study.

We derive the free cash flow FCF° as if there were 1 unit of domestic production. Then we take into account the actual levels of domestic production in the various scenarios to infer the respective cash flows FCF and the respective capex. The change in domestic production comes from the change in market size and the changes in market share of domestic producers relative to imports.

a. The free cash flow

We take the following definition of the free cash flow

$$FCF° = P – c – tax = (P\text{-}c)\text{-}\tau( P - (c – sus) - am) = (P\text{-}c)(1\text{-}\tau)+\tau(am\text{-}sus)$$

in which $\tau$ stands for the tax rate (23% as in Part I of the study), *am* for depreciation and amortization and *sus* for sustaining capex. By introducing the distinction between am and sus we allow for differences in old and new plants (typically old plants have sustaining capex higher that depreciation while the reverse is true for new plants)

We have calculated *am* as the book value times the *wacc* (taken at 6% in constant money); this is a simplification to avoid a time series associated with an accounting depreciation period.

The sustaining capex have been calculated as percentages of the adjusted book value. The adjusted book value is directly the book value for in case of new plants. For old plants the adjusted book value is taken from Part I of the study. The percentage is 4% for old plant and 2% for new plants, reflecting a lower need for sustainability expenditures.

b. The capex

The capex includes possible investment for new plants I and the closing costs Cc for old plants. If $k^n$ of new capacity is constructed the total capex and $k^o$ tons of old capacity is closed (old plants) is:

$$I\,k^n + Cc + k^o(1-\tau)$$

The capex calculations take into account the change in the size of the market induced by the changes of prices.

c. The IRR relative to the reference scenario

In this simple model the IRR is determined as follows

IRR = (FCF-FCF®)/(Capex-Capex®)

in which ® stands for the values associated with the reference scenario (no change for closing, closing for new plants and for mergers).

d. The ROCE

$$ROCE = EBIT(1-\tau)/CE$$

Using the same methodology as in Part I we take EBIT as price minus cash cost (including sustaining capex) and the capital invested as the value of capacity, this capacity calculated using the utilization rate. The value of capacity for old plants is the one used in Part I of the study.

This ROCE does not take into account the change in the size of the market nor the change in domestic market share induced by the changes of prices.

e. EVA (economic value added)

$$EVA = (ROCE - wacc)CI$$

Which allows the derivation of the change in EVA as ones goes from one scenario to the other.

The EVA calculations take into account the change in the size of the market induced by the changes of prices

f. Summary of cash flow analysis

| | Profitability analysis | | |
|---|---|---|---|
| FCF for 1t of cem sale | unit price | | P |
| | cash cost (incl sus capex) | | c |
| | ebitda/sales | | =(P-c+sus)/P |
| | utilization rate | | |
| | cement cap for 1 cement sale | | Cap° |
| | book value 1t cap | | B |
| | inv in new plants (wo env) | | |
| | adjusted book value | | AB |
| | depreciation on book (with wacc) | | am=waccB |
| | sus capex on (%) adj book value | | sus=%ABCap° |
| | free cash flow (after tax) | | FCF°= (P-c)(1-t)+t(am-sus) |
| size dom market | consumption | | |
| | dom prod | | Qd |
| | import | | |
| | import % | | |
| capacity | adjusted capacity for dom prod | | Cap=Cap°Qd |
| capex | capex (closing) | | =Cc(Cap®-Cap)(1-τ) |
| | new capex (incl envir) | | =ABQdCap° |
| | total capex | | Capex |
| FCF incl market size | free cash flow | | FCF=QdFCF° |
| vs alternative scenario ® | net free cash flow | | =FCF-FCF® |
| | IRR | | =(FCF-FCF®)/(Capex-Capex®) |
| | ROCE | | =EBIT(1-t)/AB*Cap° |
| | EVA | | =(ROCE-wacc)ABCap°Qd |
| | Delta EVA | | =EVA-EVA® |

## 6.7 Appendix 4: A selected review of the recent literature on the cement industry

Some recent papers published or under revision are now reviewed. We focus on the key papers which are directly relevant to our study both in terms of policy issues and for providing guidance for our own modeling exercise.

The first four papers concern the US market (for which public data is easily accessible). The other two papers respectively concern the Brazilian and the European markets.

1. S.P. Ryan "The costs of environmental regulation in a concentrated industry", *Econometrica*, Vol. 80, N° 3, 2012, 1019-1061.

   *Policy objective:* welfare analysis of the 1990 Clean Air Act Amendment based on the US cement industry 1980-1998.

   *Results:* The regulation increased by 20% the set up cost for new entrants leading to higher market concentration, lower profit and loss of consumer surplus (environmental gains are not accounted for); because incumbents are not affected by the regulation (grandfathering) their profit increased.

   *Methodology:* simulation of a calibrated Markov Cournot model with capacity constraint estimated on the cement industry using US Geological Survey for market county data; Mineral Yearbook for number of plants, quantity, prices by market; PCA for production and capacity of each individual (or company) plant; others for data on fuel, electricity, natural gas, coal, skilled labor, population, housing permits…

2. M. Fowlie, M. Reguant and S.P. Ryan "Market-based emissions regulation and the evolution of market structure", working paper 2011 (under revision), UC Berkeley

   *Policy objective:* analyze various national policies to mitigate $CO_2$ emissions based on the US cement industry taking into account their (dynamic) impact on industry market structure.

   *Results:* at $CO_2$ price lower than \$21/t a standard (Pigouvian) tax imposes a social welfare loss because of leakage and because of the oligopolistic nature of competition; at higher $CO_2$ prices policies with production subsidies (output based) are efficient and welfare dominates a standard policy design (as well as grandfathering or border tax adjustments); firms profit, consumer surplus and leakage are analyzed as a function of the $CO_2$ price.

   *Methodology:* based on Ryan 2012 article; introduces a competitive (import) fringe which depends on the county exposure to imports, a fixed cost for production and an investment fixed cost; environmental costs at the world level are also introduced (based on an exogenous carbon price and mitigation of emissions); abatement possibilities are not introduced.

3. G. Meunier, J-P. Ponssard and C. Thomas "Capacity Investment under Demand Uncertainty: The Role of Imports in the U.S. Cement Industry", working paper, November 2010 (under revision), Ecole Polytechnique

   *Policy objective:* Assume the market is subject to business cycles; ordinarily a capacity constrained industry will tend to increase its level of investment as the spread of the business cycle increases. How is this result affected if the industry may balance their home investments with imports, as it is the case in the US coastal cement markets?

*Results:* Using data for the US cement industry over the years 1999-2000 it is shown that the impact on the level of investment when the spread of the business cycle increases is indeed negative for coastal markets while it is positive for landlocked markets; the introduction of a carbon tax which further increases the incentive to import in high demand states would affect investment level, even if the home variable cost remains lower than the import cost.

*Methodology:* A two stage Cournot model with capacity constraint is elaborated to address theoretically the role of demand uncertainty on investment decisions; then an econometric analysis of US data shows that the empirical results are in line with the theory.

4. H. Perez-Saiz. "Building New Plants or Entering by Acquisition? Estimation of an Entry Model for the U.S. Cement Industry", working paper 2011/1, Bank of Canada

*Policy objective:* Entry in the cement industry takes place either through building a new green-field plant or acquiring (and renovating) an existing plant from a competitor. What is the impact of regulatory policies on the relative magnitude of these two industrial processes?

*Results:* It is shown that a less stringent competition policy (such as the effect of the Reagan-Bush years 1982-1992) has a lower impact in decreasing the building of new green-field plants than an environmental policy affecting asymmetrically new plants (such as the Effect of Clean Air Act Amendments of 1990 for years 1992-1997).

*Methodology:* A four stage model is used to ex0plore the idea. The model is calibrated on data from the US cement industry for years 1963-202. The impacts of regulatory policies are explored through simulations.

5. Salvo, A. "Inferring Market Power under the Threat of Entry: The Case of the Brazilian Cement Industry" *RAND Journal of Economics*, 2010, 41(2): 326-350.

*Policy objective:* Is the threat of imports into a domestic cement market, rather than actual imports, sufficient to restrain domestic oligopoly's prices?

*Results:* Evidence from Brazilian cement markets points to an important role for imports in determining domestic cement prices, despite the near absence of imports.

*Methodology:* The model assumes a competitive fringe of imports, where delivered marginal cost is high enough that imports do not occur in equilibrium, but low enough that it sometimes limits the domestic oligopoly's prices (say when the local currency is strong so that imports are at their most competitive). Not modeling this entry threat underestimates the true degree of market power. The model is tested on the Brazilian market for years 1991-2003. Over that period imports have accounted for only 1 to 2% of domestic consumption.

**6.** **G**. Meunier, J-P. Ponssard and Ph. Quirion "Carbon Leakage and Capacity-Based Allocations. Is the EU right?" Working paper September 2012, Ecole Polytechnique

*Policy objective:* discuss the economic efficiency of the EU-ETS 2013-2020 scheme for the cement industry taking into account business cycles, capacity constraints and imports.

*Results:* if a scheme similar to the EU-ETS scheme 2013-2020 had been in place in 2005 with a CO2 price at 20€/t the recent business cycle (using 2007 as a peak year and 2009 as a recession year) would have led to a significant over-investment and a large financial transfer to the cement sector through excessive free allocations (grand fathering for old plants and subsidies for new plants); a scheme using output based allocations would have performed much better.

*Methodology:* simulation of two stage model under perfect competition; the home market is subject to a business cycle; firms may invest in more efficient new plants then supply the home market through home (old and new) plants and foreign plants; as the home demand increases it becomes more and more efficient to import; the model is calibrated using data for the EU cement industry in years 2000-2010.